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# 1.5KE6.8CA Series

## 1500 Watt Mosorb™ Zener Transient Voltage Suppressors

### Bidirectional*

Mosorb devices are designed to protect voltage sensitive components from high voltage, high–energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. These devices are ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic axial leaded package and are ideally-suited for use in communication systems, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/ consumer applications, to protect CMOS, MOS and Bipolar integrated circuits.

**Specification Features:**

- Working Peak Reverse Voltage Range – 5.8 V to 214 V
- Peak Power – 1500 Watts @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μA above 10 V
- UL 497B for Isolated Loop Circuit Protection
- Response Time is typically < 1 ns

**Mechanical Characteristics:**

**CASE:** Void-free, transfer-molded, thermosetting plastic
**FINISH:** All external surfaces are corrosion resistant and leads are readily solderable
**MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES:** 230°C, 1/16″ from the case for 10 seconds
**POLARITY:** Cathode band does not imply polarity
**MOUNTING POSITION:** Any

**MAXIMUM RATINGS**

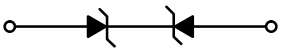
| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Peak Power Dissipation (Note 1.) @ $T_L \le 25°C$ | $P_{PK}$ | 1500 | Watts |
| Steady State Power Dissipation @ $T_L \le 75°C$, Lead Length = 3/8″ | $P_D$ | 5.0 | Watts |
| Derated above $T_L = 75°C$ | | 20 | mW/°C |
| Thermal Resistance, Junction–to–Lead | $R_{\theta JL}$ | 20 | °C/W |
| Operating and Storage Temperature Range | $T_J$, $T_{stg}$ | – 65 to +175 | °C |

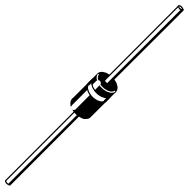
1. Nonrepetitive current pulse per Figure 4 and derated above $T_A = 25°C$ per Figure 2.

*Please see 1N6267A to 1N6306A (1.5KE6.8A – 1.5KE250A) for Unidirectional Devices

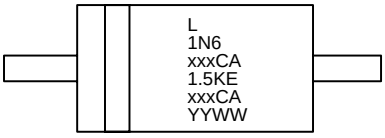
ON Semiconductor™

http://onsemi.com





**AXIAL LEAD**
**CASE 41A**
**PLASTIC**




L = Assembly Location
1N6xxxCA = JEDEC Device Code
1.5KExxxCA = ON Device Code
YY = Year
WW = Work Week

**ORDERING INFORMATION**

| Device | Packaging | Shipping |
|---|---|---|
| 1.5KExxCA | Axial Lead | 500 Units/Box |
| 1.5KExxCARL4 | Axial Lead | 1500/Tape & Reel |

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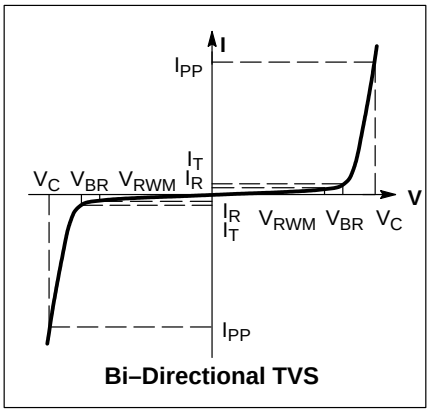
**ELECTRICAL CHARACTERISTICS**
($T_A$ = 25°C unless otherwise noted)

| Symbol | Parameter |
|---|---|
| $I_{PP}$ | Maximum Reverse Peak Pulse Current |
| $V_C$ | Clamping Voltage @ $I_{PP}$ |
| $V_{RWM}$ | Working Peak Reverse Voltage |
| $I_R$ | Maximum Reverse Leakage Current @ $V_{RWM}$ |
| $V_{BR}$ | Breakdown Voltage @ $I_T$ |
| $I_T$ | Test Current |
| $\Theta V_{BR}$ | Maximum Temperature Coefficient of $V_{BR}$ |



**Bi–Directional TVS**

**ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise noted.)

| Device | $V_{RWM}$ (Note 1) (Volts) | $I_R$ @ $V_{RWM}$ (μA) | Breakdown Voltage $V_{BR}$ (Note 2) (Volts) Min | Nom | Max | @ $I_T$ (mA) | $V_C$ @ $I_{PP}$ (Note 3) $V_C$ (Volts) | $I_{PP}$ (A) | ΘV$_{BR}$ (%/°C) |
|---|---|---|---|---|---|---|---|---|---|
| 1.5KE6.8CA | 5.8 | 1000 | 6.45 | 6.8 | 7.14 | 10 | 10.5 | 143 | 0.057 |
| 1.5KE7.5CA | 6.4 | 500 | 7.13 | 7.5 | 7.88 | 10 | 11.3 | 132 | 0.061 |
| 1.5KE8.2CA | 7.02 | 200 | 7.79 | 8.2 | 8.61 | 10 | 12.1 | 124 | 0.065 |
| 1.5KE9.1CA | 7.78 | 50 | 8.65 | 9.1 | 9.55 | 1 | 13.4 | 112 | 0.068 |
| 1.5KE10CA | 8.55 | 10 | 9.5 | 10 | 10.5 | 1 | 14.5 | 103 | 0.073 |
| 1.5KE11CA | 9.4 | 5 | 10.5 | 11 | 11.6 | 1 | 15.6 | 96 | 0.075 |
| 1.5KE12CA | 10.2 | 5 | 11.4 | 12 | 12.6 | 1 | 16.7 | 90 | 0.078 |
| 1.5KE13CA | 11.1 | 5 | 12.4 | 13 | 13.7 | 1 | 18.2 | 82 | 0.081 |
| 1.5KE15CA | 12.8 | 5 | 14.3 | 15 | 15.8 | 1 | 21.2 | 71 | 0.084 |
| 1.5KE16CA | 13.6 | 5 | 15.2 | 16 | 16.8 | 1 | 22.5 | 67 | 0.086 |
| 1.5KE18CA | 15.3 | 5 | 17.1 | 18 | 18.9 | 1 | 25.2 | 59.5 | 0.088 |
| 1.5KE20CA | 17.1 | 5 | 19 | 20 | 21 | 1 | 27.7 | 54 | 0.09 |
| 1.5KE22CA | 18.8 | 5 | 20.9 | 22 | 23.1 | 1 | 30.6 | 49 | 0.092 |
| 1.5KE24CA | 20.5 | 5 | 22.8 | 24 | 25.2 | 1 | 33.2 | 45 | 0.094 |
| 1.5KE27CA | 23.1 | 5 | 25.7 | 27 | 28.4 | 1 | 37.5 | 40 | 0.096 |
| 1.5KE30CA | 25.6 | 5 | 28.5 | 30 | 31.5 | 1 | 41.4 | 36 | 0.097 |
| 1.5KE33CA | 28.2 | 5 | 31.4 | 33 | 34.7 | 1 | 45.7 | 33 | 0.098 |
| 1.5KE36CA | 30.8 | 5 | 34.2 | 36 | 37.8 | 1 | 49.9 | 30 | 0.099 |
| 1.5KE39CA | 33.3 | 5 | 37.1 | 39 | 41 | 1 | 53.9 | 28 | 0.1 |
| 1.5KE43CA | 36.8 | 5 | 40.9 | 43 | 45.2 | 1 | 59.3 | 25.3 | 0.101 |
| 1.5KE47CA | 40.2 | 5 | 44.7 | 47 | 49.4 | 1 | 64.8 | 23.2 | 0.101 |
| 1.5KE51CA | 43.6 | 5 | 48.5 | 51 | 53.6 | 1 | 70.1 | 21.4 | 0.102 |
| 1.5KE56CA | 47.8 | 5 | 53.2 | 56 | 58.8 | 1 | 77 | 19.5 | 0.103 |
| 1.5KE62CA | 53 | 5 | 58.9 | 62 | 65.1 | 1 | 85 | 17.7 | 0.104 |
| 1.5KE68CA | 58.1 | 5 | 64.6 | 68 | 71.4 | 1 | 92 | 16.3 | 0.104 |
| 1.5KE75CA | 64.1 | 5 | 71.3 | 75 | 78.8 | 1 | 103 | 14.6 | 0.105 |
| 1.5KE82CA | 70.1 | 5 | 77.9 | 82 | 86.1 | 1 | 113 | 13.3 | 0.105 |
| 1.5KE91CA | 77.8 | 5 | 86.5 | 91 | 95.5 | 1 | 125 | 12 | 0.106 |
| 1.5KE100CA | 85.5 | 5 | 95 | 100 | 105 | 1 | 137 | 11 | 0.106 |
| 1.5KE110CA | 94 | 5 | 105 | 110 | 116 | 1 | 152 | 9.9 | 0.107 |
| 1.5KE120CA | 102 | 5 | 114 | 120 | 126 | 1 | 165 | 9.1 | 0.107 |
| 1.5KE130CA | 111 | 5 | 124 | 130 | 137 | 1 | 179 | 8.4 | 0.107 |
| 1.5KE150CA | 128 | 5 | 143 | 150 | 158 | 1 | 207 | 7.2 | 0.108 |
| 1.5KE160CA | 136 | 5 | 152 | 160 | 168 | 1 | 219 | 6.8 | 0.108 |
| 1.5KE170CA | 145 | 5 | 162 | 170 | 179 | 1 | 234 | 6.4 | 0.108 |
| 1.5KE180CA | 154 | 5 | 171 | 180 | 189 | 1 | 246 | 6.1 | 0.108 |
| 1.5KE200CA | 171 | 5 | 190 | 200 | 210 | 1 | 274 | 5.5 | 0.108 |
| 1.5KE220CA | 185 | 5 | 209 | 220 | 231 | 1 | 328 | 4.6 | 0.109 |
| 1.5KE250CA | 214 | 5 | 237 | 250 | 263 | 1 | 344 | 5 | 0.109 |

1. A transient suppressor is normally selected according to the maximum working peak reverse voltage ($V_{RWM}$), which should be equal to or greater than the dc or continuous peak operating voltage level.
2. $V_{BR}$ measured at pulse test current $I_T$ at an ambient temperature of 25°C.
3. Surge current waveform per Figure 4 and derate per Figures 1 and 2.

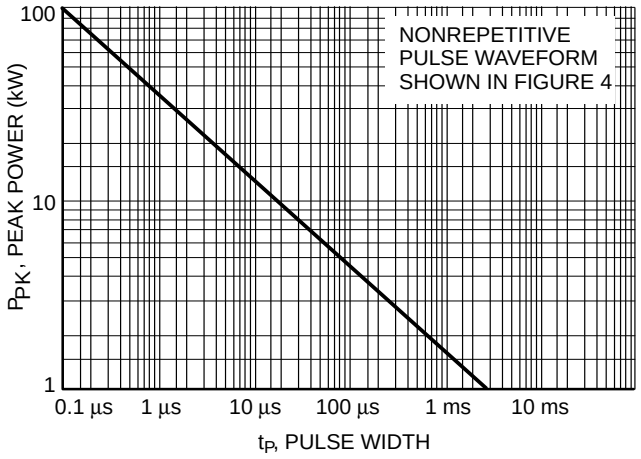



**Figure 1. Pulse Rating Curve**

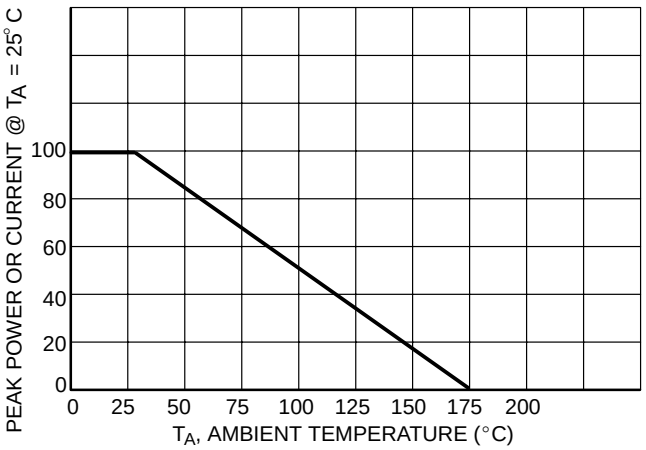



**Figure 2. Pulse Derating Curve**

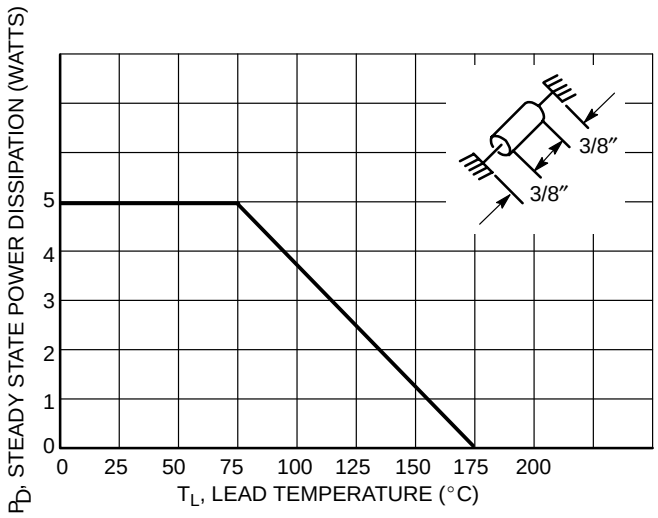



**Figure 3. Steady State Power Derating**

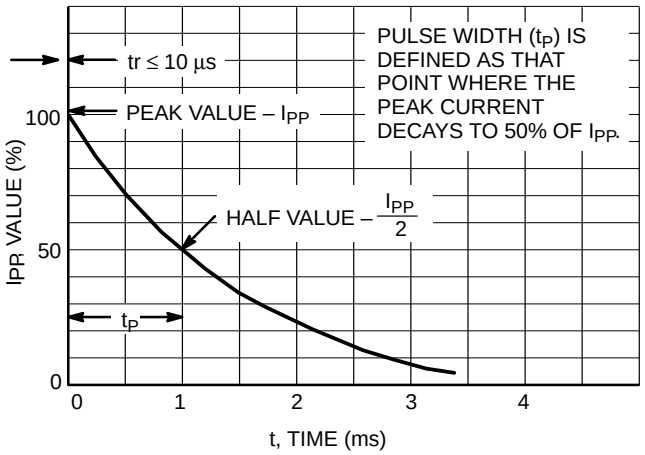



**Figure 4. Pulse Waveform**

**1N6373, ICTE-5, MPTE-5,**
**through**
**1N6389, ICTE-45, C, MPTE-45, C**

**1.5KE6.8CA**
**through**
**1.5KE200CA**

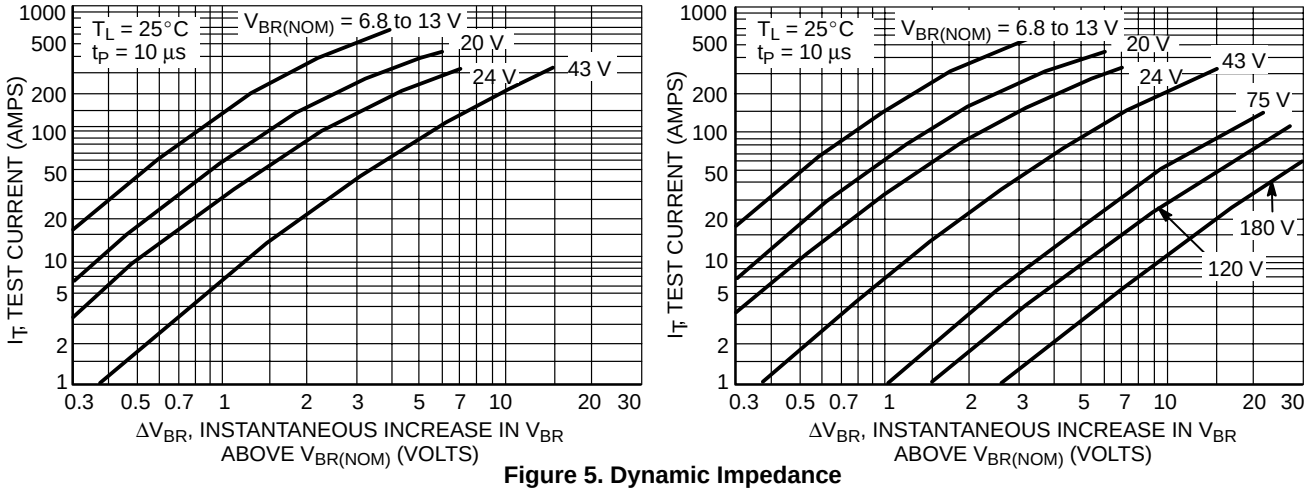



**Figure 5. Dynamic Impedance**

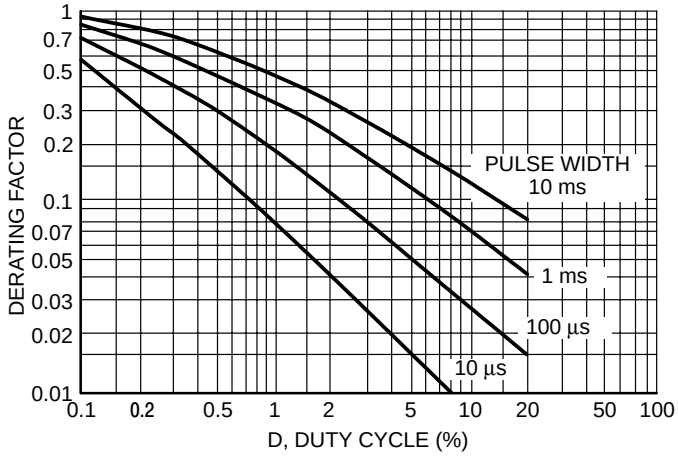



**Figure 6. Typical Derating Factor for Duty Cycle**

## APPLICATION NOTES

### RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitance effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 7.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure 8. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. These devices have excellent response time, typically in the picosecond range and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

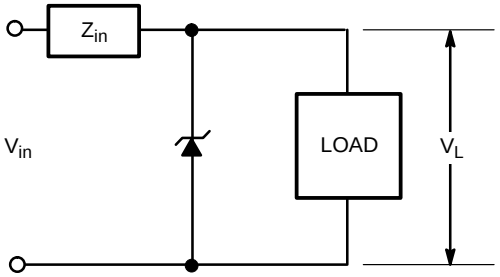
Some input impedance represented by $Z_{in}$ is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

### DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 6. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 6 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μs pulse. However, when the derating factor for a given pulse of Figure 6 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

## TYPICAL PROTECTION CIRCUIT



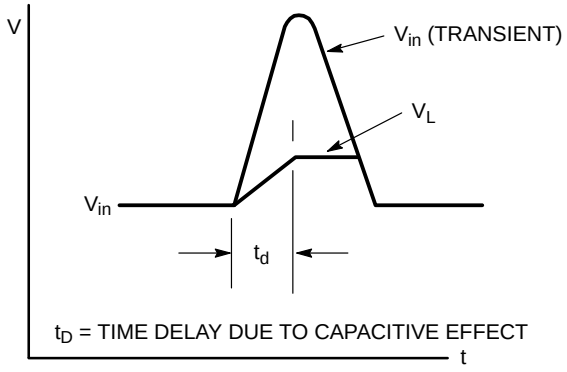




**Figure 7.**

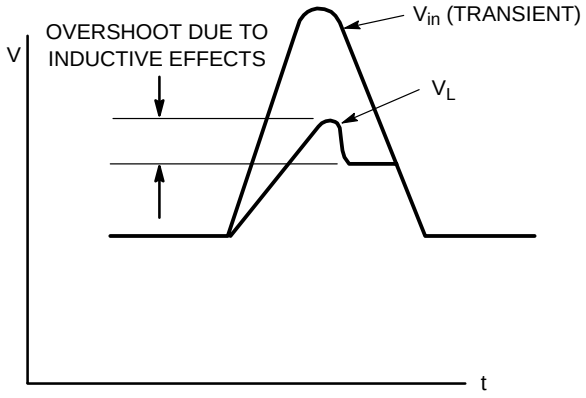



**Figure 8.**

## UL RECOGNITION*

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their Protector category.

*Applies to 1.5KE6.8CA – 1.5KE250CA

## CLIPPER BIDIRECTIONAL DEVICES

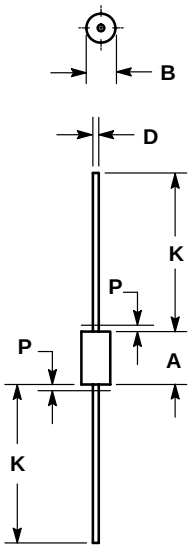
1. Clipper-bidirectional devices are available in the 1.5KEXXA series and are designated with a “CA” suffix; for example, 1.5KE18CA. Contact your nearest ON Semiconductor representative.
2. Clipper-bidirectional part numbers are tested in both directions to electrical parameters in preceeding table (except for $V_F$ which does not apply).
3. The 1N6267A through 1N6303A series are JEDEC registered devices and the registration does not include a “CA” suffix. To order clipper-bidirectional devices one must add CA to the 1.5KE device title.

**OUTLINE DIMENSIONS**

# Transient Voltage Suppressors – Axial Leaded

## 1500 Watt Mosorb™

**MOSORB**
CASE 41A–04
ISSUE D




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. LEAD FINISH AND DIAMETER UNCONTROLLED IN DIMENSION P.
4. 041A–01 THRU 041A–03 OBSOLETE, NEW STANDARD 041A–04.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.335 | 0.374 | 8.50 | 9.50 |
| B | 0.189 | 0.209 | 4.80 | 5.30 |
| D | 0.038 | 0.042 | 0.96 | 1.06 |
| K | 1.000 | --- | 25.40 | --- |
| P | --- | 0.050 | --- | 1.27 |

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